HOMOEPITAXIAL AND POLYCRYSTALLINE CVD DIAMOND PN-JUNCTIONS

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Abstract

Up to date, in-situ phosphorous doping of CVD diamond remains the only well-established method to achieve n-type diamond films. Several research groups in the world have used the MW PE CVD technique in combination with a P-containing precursor gas, leading to the successful deposition of active P-doped films [1-3].

Most of the n-type doping efforts are focused on homoepitaxial growth using {111}-oriented HPHT Ib substrates. As {100}-oriented n-type diamond remains a problem, diamond pn-junctions are based on stacking of a n-type layer upon a {111}-oriented B-doped film, deposited on a Ib substrate. In order to improve the diode characteristics, usually a thin undoped, intrinsic CVD diamond layer is deposited between the two doped layers, creating a pin-diode. By making use of selective RIE, ohmic contacts can be deposited on both doped layers.

For this work we have deposited a set of pin-diodes under similar doping conditions, but varying the intrinsic layer thickness. We will discuss their I-V characteristics and their UV-response around the band gap.

As is known, the substrate-size is still a limiting factor in the production of n-type films and pn-junctions on larger areas. Recently, at IMO the first polycrystalline n-type films and pn-junctions were deposited making use of a polished polycrystalline CVD diamond as substrate [4,5]. Now we optimised the orientation of this substrate and looked at the morphology of the n-type layer grown on top. Using SEM, EBSD and Orientation Imaging Microscopy (OIM) images we show the relation between the grain orientation of the substrate and the grain grown on top. The novel OIM technique allows the determination of grain orientations over the complete thickness of the film. Finally, Hall-measurements on P-doped polycrystalline n-type films will show the active n-type character of these films.

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